THE IMPACT OF MENU LABELS ON CHANGING EATING BEHAVIORS: AN EXPERIMENTAL STUDY

A Thesis

Presented to the Faculty of the Graduate School

of Cornell University

In Partial Fulfillment of the Requirements for the Degree of

Master of Science

by

Wansopin Amatyakul

May 2013

ABSTRACT

Conducting a laboratory experiment with 298 student subjects, we examine the impact of various menu labeling formats, such as nutrition facts, total calories, health icons, and health claims, on consumer eating behavior. A difference-in-differences analysis and an ordered probit regression model are performed to evaluate the effectiveness of each labeling format. We find all types of labeling to have a significant negative impact on content of total calories, total fat, saturated fat, and carbohydrates in the selected meal. In addition, we find that the menu labels significantly impact the selection towards healthier choices, particularly among entrée. Therefore, our results suggest that various formats of nutrition information provided on the restaurant menus promote healthy food choices, supporting the rationale behind the menu labeling legislation.

BIOGRAPHICAL SKETCH

Wansopin Amatyakul was born in Bangkok, Thailand in 1986. She earned a Bachelor of Business Administration degree in the field of Accounting in May 2008 from the Faculty of Commerce and Accountancy at Chulalongkorn University, Thailand, and was employed for three years in that career field. Being inspired by elegant application of economic theories that was very beneficial in the business context, she obtained a scholarship sponsored by The Royal Thai Government to pursue a course of study leading to a Master's degree in Applied Economics and Management at Cornell University in 2011. After graduation in 2013, she will return to her home country to work as a government official in the Department of Foreign Trade, Ministry of Commerce, according to the commitment specified by the scholarship contract.

Switching a career path from accounting to applied economics was very challenging. Having gone through several diversified courses relating to public policy issues, she was well equipped with sufficient knowledge and research skill to prospectively apply economic theories to suit her country's best needs. Besides academic aspects, living in dynamic international environment enriched her experiences in adapting herself to the multicultural society. Her goal for the future is to become a policymaker analyzing current trading situations and explore optimal policies to improve her country's competitiveness in the global markets.

ACKNOWLEDGMENTS

First of all, I feel deeply honored to have been awarded the prestigious scholarship from the Royal Thai Government, which gave me an invaluable opportunity to pursue my study at Cornell University.

I would like to express my sincere gratitude to my advisor, Professor Harry M. Kaiser, for his excellent guidance and patience throughout the research process. His considerate advice and attentive editing improved my analytical thinking and thoroughly helped complete my thesis. I am grateful for useful academic comments regarding the econometrics model I received from Assistant Professor Jura Liaukonyte. I also appreciate the assistance from my colleagues, Pimbucha Rusmevichientong and Nadezhda Streletskaya, for their cordial cooperation in developing mutual experimental platform and providing a conducive atmosphere for working as a team.

I would like to thank many professors in Department of Applied Economics and Management whom I have taken classes with for the knowledge and practical research skills to be applied in my thesis.

Lastly, I am very thankful for the moral support and words of encouragement from my family and friends who always cheered me up and stood beside me during the stressful time.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Obesity is a tremendous social problem in the United States with over 34% of the population categorized as obese and over 67% classified as overweight (World Health Organization, 2012). This problem, which has become substantially more prevalent in the past two decades, is associated with significant health problems, such as cardiovascular disease, diabetes, and certain types of cancer, which, in turn, have increased health care costs to approximately $150 billion per year (Lillis, 2010).

The increase in consumption of away-from-home food has been cited as one of the primary causes for higher levels of obesity. Food away-from-home typically contains more levels of calories, fat, sodium, and added sugar while offering fewer vegetables, fruits and foods rich in fiber. Also, the "supersizing" of food and beverage portions at fast food establishments and consumers' underestimation of actual caloric contents of foods in restaurants have been attributed to an escalation of obesity in the United States (Kuo et al., 2009; Roberto et al., 2010). The average portion sizes of soda, French fries, and hamburgers offering at fast food establishments have increased by 49, 68, and 97 calories respectively since 1970s (Nielsen & Popkin, 2003) and within the same chain operations, the portion sizes for sale in the U.S. are larger than those in Europe (Young & Nestle, 2007). The larger portion size of these foods prepared outside home encourages over-consumption. For instance, a study by Paeratakul et al. (2003) showed that when eating out adults and children consumed on average 205 and 155 calories per day more than when eating at home. Moreover, most consumers are not aware of how much they eat as they tend to underestimate calorie content in their food purchase and the underestimation increases with meal size (Burton et al., 2009).

Improving and promoting healthy eating habits has become the focus of the American national health policy. Several policies have been proposed to address the issue of obesity and one of those that has recently received public attention is providing mandatory nutrition information at restaurants to consumers. While the Nutrition Labeling and Education Act (NLEA) of 1990 requires the presentation of nutrition fact panels on packaged foods, it is not compulsory for restaurants to provide such information on prepared meals. However, restaurants provide a major part of American diet. According to the National Restaurant Association (2013), American spent 47% of their food dollar in the restaurant industry in 2012, up from 26% in 1970 (Friedman, 2008). This trend corresponded to a dramatic increase in total expenditures spent on away-from-home foods from $406.3 billion in 2001 to $641.2 in 2011, a rise of almost 58% (United States Department of Agriculture [USDA], 2013).

Given the recent upward trend in food consumed away-from-home and the projected rise of obesity, many cities, counties, and states have proposed legislation requiring the posting of nutrition information on the restaurant menus. This policy is well supported by the U.S. public as suggested by various national and state/county polls (e.g. Caravan Opinion research Corporation 2008, Technomic Inc.'s Nutritrack Consumer Nutrition Insights online survey 2007, ARAMARK Corporation 2005) (Friedman, 2008). Currently, menu labeling laws have been passed and implemented in three cities (New York City, NY; Nashville, TN; Philadelphia, PA), six counties (King County, WA; Montgomery, MD; Multnomah County, OR; Ulster County, NY;

Westchester County, NY; Suffolk County, NY), and four states (CA, ME, MA, OR) (FoodCalc, 2013). The laws mandate food-chains to display caloric and nutrient contents, such as content of saturated fat, carbohydrates, and sodium, of menu items to customers at the point-of-purchase (e.g. menus and menu boards). This initiative is aimed at reducing customers' search costs and improving consumers' understanding of nutrition information, thereby removing optimistic bias from calorie underestimation and encouraging a selection of healthier food choices (Berman & Lavizzo-Mourey, 2008; Dumanovsky et al., 2010).

Apart from the legal requirements for displaying calorie and nutrient content, several restaurants have introduced a variety of health cues, such as posting healthy heart symbols, check mark signs, or simply marking menu entries as "low calorie" or "low carb", to help customers process health-related information more easily and conveniently identify healthier items on their menus. These health cues vary in styles and framing and can come with or without words and symbols. Although the content of the communication message made by the restaurants has to follow the claim definitions guidelines by the NLEA, it is not as strict as those of packaged foods because it is more difficult to verify (Kozup el al., 2003).

The information messages can be divided into nutrition and health claims. Nutrition claims identify particular benefits as a result of the existence/non-existence of some nutrients in the food (e.g. low fat) while health claims draw a link between a specific nutrient contained in the food to a disease or health condition. Health claims are usually comprised of three parts, which include an active ingredient, an effective function, and a health benefit (Dean et al., 2011). An example of a health claim is “contains calcium (ingredient) that increase bone mass (function) which reduces risk of osteoporosis (benefit)”.

Given the variety of menu labeling formats available for restaurants, each of these may have a different impact on consumers’ perception in terms of relative healthiness of the food, affecting their purchasing decisions. Accordingly, the purpose of this research is to explore the impact of these formats on conveying the health-related information to customers and encouraging them to select healthy food items when purchasing an away-from-home meal. The analysis is based on an economic experiment conducted with 298 university student subjects where students purchased luncheon items based on various menus that consisted of four different nutrient/health information treatments. The menus were identical in item selection, but differed in labeling and nutritional information provided. The treatments included the following information labels beside each menu item: (1) total calories posting, (2) complete nutrient contents, (3) healthy and unhealthy food icons, and (4) health-related scientific statement about the nutrients contained in the item. The overall goal of the research is to provide empirical evidence of the impact of the different types of menu labels on nudging people towards healthier eating habits to inform the policy debate on anti-obesity policy.

CHAPTER 2

LITERATURE REVIEW

Although menu labeling laws have only recently been implemented, research on the effectiveness of nutrition information has been done for at least three decades (Webb et al., 2011). One of the first papers published was Millich et al. (1976), who examined the impact of calorie values presentation on food purchasing decision for female subjects in a hospital cafeteria and found a significant decrease in the total calories purchased across all weight conditions (normal, overweigh, and obese). Several studies have used university students as subjects in investigating nutritional information impacts. For instance, Driskell et al. (2008) and Conklin et al. (2005) analyzed eating habits of students in a university dining hall after being exposed to a simplified version of nutrition facts, which exclude information about saturated fat, trans fat, dietary fiber, and sugars. The result showed that the majority of students reported being aware of the label and said that it influenced them in making food choices, with a higher proportion of female students being impacted. This pattern of different responses between genders was confirmed with a hypothetical choice laboratory experiment in a university conducted by Gerend (2009). Women ordered meals with fewer calories when presented with a menu listing the number of calories per item, compared to a menu without it, while the meal selections by men between two conditions were not different. One limiting factor in these studies is their reliance on self-reported perceptions and intentions of respondents rather than actual selections and hence further research is needed to determine whether different nutrition messages impact actual selections among different demographic groups.

Several studies used field experiment in a university or worksite cafeteria setting to explore changes in actual purchasing behavior of consumers before and after placing nutrition information at the point of selection. Cranage et al. (2004) and Chu et al. (2009) focused their attention on posting calories and some nutrient contents to entrée items in a campus cafeteria. After labeling the menu, the number of relative higher fat and higher calorie entrée selections dropped between 47% to 67% and customers expressed positive feedback for the presence of nutrition information (Cranage et al., 2004). Also, the average calories consumed for the main entrée decreased immediately without any changes in number of entrées sold or in the cafeteria's revenue. However, after the removal of menu labeling, the average calorie intake gradually increased once again (Chu et al., 2009). Another study conducted by Webb et al. (2011) at a hospital cafeteria with the use of nutrition information applied to all menu items suggested that 74% of customers agreed that the posted information was useful in selecting food choices, and corresponded with a significant rise in the sales of healthier side dish and snacks. However, unlike the previous two studies reviewed, there was no change in the sale of main entrées. In contrast to the promising results of the above studies, an experiment by Harnack et al. (2008) suggested that there was no significant difference in number of calories between participants who chose items from menus with and without calorie information. Yamamoto et al. (2005) also reported similar results with his experimental study of adolescents regarding the presence or absence of calorie and fat content information.

Apart from traditional nutrition information disclosure, some studies explored alternative ways of presenting the information to compare their effectiveness with the traditional one. Participants in an experiment carried out by Roberto et al. (2010) were randomly assigned to one of the three different menus, two of them were menus with and without calorie label and the other one was a calorie label plus information of a recommended daily caloric intake of 2,000 calories. The result showed that there was no statistically significant difference between two ways of calorie labeling, but when combining them together, the amount of calorie consumed by participants using these menus were still lower than those using menu with no calorie information. Balfour et al. (1996) examined the impact of nutrition information when it was graphically displayed tailoring by each customer's food choice and observed whether customers would change their previously selected meal after seeing the graph. He found that those who chose to switch choices significantly reduced the amount of calorie, fat, and sugar intake in their second selection, compared with their first selection. In addition, the amount of nutrients in this second selection was at the level similar to that of people who had already been satisfied with their first selection, indicating that the nutrition information had an impact on customers who consumed more than average. Besides the presentation of absolute caloric count, Bleich et al. (2012) proposed two other alternatives, which included percentage of total calorie recommended for daily intake and physical activity equivalent. Their field experiment focused on the purchasing behavior of low-income black adolescents for sugar-sweetened beverages (SSB). The results confirmed that all three caloric formats (absolute caloric count, percentage of total calorie recommended for daily intake and physical activity equivalent) helped reduce the likelihoods of SSB purchases with the last format the most effective. The last two studies indicate that simplifying the caloric and nutrition information is a possible way to improve the usage of the label to make healthier food selection.

Despite some favorable results of menu labeling initiative, Burton et al. (2006, 2009) argued that its effectiveness did not depend on the information disclosure per se, but rather it relied on the relationship between actual and expected nutrition levels. Disclosure of nutrition information would have an influence on food choice selection only when customers' expectations about the level of nutrients were not met, while it would have no impact when their expectations were met. Additionally, Giesen et al. (2011) found out that the provision of calorie information intervened with an impact of another obesity-combating policy, an unhealthy tax scheme. A food tax would cause a reduction in the level of calorie consumed only without a presence of nutrition information.

Among those legal jurisdictions which implemented the mandatory calorie posting laws, New York City was considered the pioneer. Right before its implementation, Bassett et al. (2008) verified the need of this law by surveying fast-food chains in NYC. His result supported an introduction of the law as Subway, which was the one voluntarily food chain providing calorie information at point-of-purchase, had a much higher proportion of patrons noticing calorie information and effectively using it to lower their amount of calories intake. Dumanovsky et al. (2010) compared consumers' awareness of calorie information and purchase intention in all qualified NYC restaurants before and after the enactment of the law and found an increase in the number of people who used the information after the post-enforcement. Subsequent studies used the natural experiment to assess the impact of calorie posting.

According to Bollinger et al. (2010), sales data from Starbucks in NYC provided evidence of a reduction in average calories per transaction as a result of a change in food choices. However, there were contrasting results from other studies as well. Finkelstein et al. (2011) and Elbel et al. (2009) found no significant changes in the calories content of foods purchased from the King County, Washington fast food chain and NYC restaurants located in low-income areas where African Americans and Latino lives. Similarly, insignificant and mixed impacts of calorie posting in NYC were found by Downs et al. (2009) and suggested that in some population groups, calorie posting could yield perverse effect, such as promoting higher calories intake for dieters.

At present, it is still inconclusive whether calorie posting laws are effective in dealing with the current obesity problem. Results from previous evaluations of restaurant menu labeling are quite inconsistent and the magnitude of the effect is limited to certain extent. This may be due to the variety of formats and amount of nutrition information supplied. Another possible explanation is the difference in types of experiments used, all with their own limitations, such as social desirability bias from surveys, absence of randomized controlled design from field experiments, and unrealistic food purchasing conditions from the laboratory. Additionally, most studies failed to track individual behavioral changes across menu conditions. Thus, an alternative method is a controlled laboratory experiment that incorporates real food purchases and participants randomized into treatment groups.

As an increasing number of restaurants creatively customize their menus with a use of healthy icons and health claims to encourage customers to choose healthier choices, several studies explored their impact on food purchased decisions and the results were inconclusive. On the one hand, Johnson et al. (1990) found no impact of "low calorie" label on calorie selection, even for people with a high dietary restraint condition, and the same results were found by Vyth et al. (2011) that used the "Choices" nutrition logo. A finding by Albright et al. (1990) suggested a mixed result that two out of four restaurants' sales of targeted food with a red heart label (low fat and low cholesterol) were affected. According to Cinciripini (1984) and Dubbert et al. (1984), a "green triangle foods" icon (lower fat and calories) and a lower calorie label, respectively, resulted in a rise in sales of vegetables, fruits, and low-fat dairy items, while the sales of entrée items remained unchanged. On the other hand, Levin (1996) reported a significant increase in sales of low-fat entrée items, designated by a heart-shaped label, and the impact held for all major demographic groups. Recently, a focus group study conducted by Jones (2010) and Lando and Labiner-Wolfe (2007) suggested that health icons partly encouraged healthier choice by changing customers' food ranking and removing unhealthy entrée from their consideration. Moreover, this impact could occur only if the description of the icons was understandable and trustable.

An impact of health claims on food selections has been studied extensively, but most studies have concentrated on packaged food products or advertising. Kozup et al. (2003) investigated consumers' attitude of a "heart-healthy" claim, showing the potential development of coronary heart disease from an intake of saturated fat and cholesterol, in the restaurant menu context. The result showed that the claim positively influenced nutrition attitude and purchase intention only with the absence of nutrition information. However, sufficient knowledge of the diet-disease relation may be necessary for the usefulness of nutrient content information. In addition, generic diet-disease information was more preferred to product-specific nutrient messages as consumers viewed the latter one as a form of marketing tool (Teisl et al., 1999) and the level of claim influence on buying intention depended on personal relevance (Dean et al., 2011). To our knowledge, there has been no research exploring this type of health claim on restaurant menus. Thus, this paper will investigate its impact as a comparison to other labeling formats within one setting. In addition to traditional menu labels that usually provide only positive information about food content, this paper will include negative health claims and negative icons to explore their impact on purchasing decisions as well.

The purpose of the research summarized here is to examine how four types of menu labeling format concerning health-related information impact consumers' purchases of lunch items. By conducting a laboratory experiment, our objective is to replicate the impact of calorie posting law from previous studies in a complete control environment and to examine potential alternative labeling formats that could help improve the effectiveness of the existing labeling policy.

CHAPTER 3

METHODOLOGY

3.1 Experimental Design

A total of 298 university student subjects participated in the economic experiment, sessions of which were held at noon to coincide with lunch. Subjects were paid $15 in cash for participation plus a $10 voucher that could be spent exclusively on food items selected from their menus. During the experiment, subjects completed a series of computerized menus, varying depending on the treatment, interspersed with television show excerpts.

At the beginning of the experiment, subjects were informed that they would be filling out a series of computerized lunch menus with a $10 endowment to pay for the food items selected on each menu. Participants were told that spending more than the given $10 endowment on their menu choices was allowable, but would result in the excess amount over $10 endowment being deducted from their $15 participation payment. However, in case of spending less than the $10 endowment, subjects were instructed that the difference would not be reimbursed to them in cash. Subjects were further told that one of the menus was randomly drawn before the experiment started and it would be revealed at the end of the experiment. The choice of lunch food items on the announced menu would become binding for the subjects. Since subjects did not know which menu would be chosen, they were incentivized to complete each menu as if it would be the one chosen, revealing their true preferences.

The experiment began with a first menu presented to subjects on their computer screens and they were asked to put the number of servings they would like to have for lunch next to the desired item. The total cost of all selected items was automatically calculated and displayed at the bottom of the menu. The menu was constructed to contain a sufficient number of relatively healthy and unhealthy items. The list of all items offered on the menu and their prices is provided in Table 3.1.

Table 3.1 : List of items offered on the lunch menu and their respective prices

Food menu	Prices ($)
Diet Pepsi	2.00
Pepsi	2.00
Gatorade Low Calorie	2.33
Mountain Dew	2.00
Unsweetened Iced Tea LIPTON	2.15
Original Iced Tea LIPTON	2.15
Lemonade Tropicana	2.59
Bottled Water	1.95
Green Salad with Sesame Oriental/Balsamic Dressing	7.03
Green Salad with Tuna with Sesame Oriental/Balsamic Dressing	7.03
Veggie Cup with Hummus or Light Ranch	4.32
Cheese Pizza (personal pan 6")	5.18
Pepperoni Pizza (personal pan 6")	5.83
Local Bacon Cheeseburger	7.52
Lean Turkey Whole Grain Sandwich	6.16
Macaroni & Cheese	4.53
Doritos Nacho Cheese	1.55
Fresh Apple	1.00
Fresh Banana	1.00
Fresh Orange	1.00
Chocolate Chip Cookies	2.20
Brownie Bar	1.94

Prices of relatively healthy and unhealthy items were set to be similar in order to eliminate potential price effect in the menu selection. After completing the first menu, subjects watched an approximately six minute mix of television show excerpts from “Portlandia”, a comedy series from the Independent Film. The first 3.25 minutes came from an episode of “One Moore Episode” (2012) and the latter 2.30 minutes came from an episode of “Mayor is Missing” (2011). Then, a second menu was presented to subjects. After filling out the second menu, subjects were directed to a computerized questionnaire revealing their attitudes towards organic food, their health habits and some demographic information (see Appendix 1).

The experiment had one control group, where the first and the second menu were exactly the same, and four additional treatments, where the second menu was identical to the first menu in terms of the items offered and prices, but had a different health-related information labels or icons. The first treatment was the calorie-only treatment, where the amount of calories was indicated in parenthesis after the name of the lunch items (see Table 3.2). The second was the full nutrition facts labeling treatment, where a table of standard nutrition information of each menu item based on the Nutrition Labeling and Education Act requirements from Food and Drug Administration was shown as a pop-up box when subjects moved their mouse over the name of the item. An example of a nutrition table is illustrated in Table 3.3 (see a full list of nutrition facts for all lunch items in Appendix 2). The third was the healthy, unhealthy icon treatment, where symbols were placed in front of the description of some lunch items to indicate whether they were relatively healthy or less healthy (see Figure 3.1). Unlike most previous studies, we included a negative, unhealthy food icon on the unhealthy food items. The final treatment was the health claim treatment, where scientific facts about main nutrients contained in some lunch items were shown as a pop-up box when subjects moved their mouse over the name of the item. A list of all health claims is provided in Table 3.4. Again, this study was somewhat unique in the inclusion of negative health claims on unhealthy food items.

Table 3.2 : Amount of calories associated with items offered on the lunch menu

Food menu
Diet Pepsi (0 Calorie)
Pepsi (250 Calories)
Gatorade Low Calorie (45 Calories)
Mountain Dew (290 Calories)
Unsweetened Iced Tea LIPTON (0 Calorie)
Original Iced Tea LIPTON (150 Calories)
Lemonade Tropicana (300 Calories)
Bottled Water (0 Calorie)
Green Salad with Sesame Oriental/Balsamic Dressing (137 Calories)
Green Salad with Tuna with Sesame Oriental/Balsamic Dressing (316 Calories)
Veggie Cup with Hummus or Light Ranch (84 Calories)
Cheese Pizza (personal pan 6") (517 Calories)
Pepperoni Pizza (personal pan 6") (530 Calories)
Local Bacon Cheeseburger (683 Calories)
Lean Turkey Whole Grain Sandwich (329 Calories)
Macaroni & (491 Calories)
Doritos Nacho Cheese (294 Calories)
Fresh Apple (72 Calories)
Fresh Banana (105 Calories)
Fresh Orange (62 Calories)
Chocolate Chip Cookies (108 Calories)
Brownie Bar (224 Calories)

By providing various forms of additional health-related information on the second menu, it is hypothesized that the total amount of calories from all selected items on the second menu will be lower compared to the first menu, which has no additional health-related information. This hypothesis is based on the assumption that exposing customers to nutrients containing in their food choices will encourage them to switch lunch items towards relatively more healthy food options.

Table 3.3: An example of a pop-up nutrition table

Nutrition Fact: Diet Pepsi	
Calories	0
Calories from Fat	0
Total Fat (g)	0
Sat Fat (g)	0
Tran Fat (g)	0
Cholesterol (mg)	0
Sodium (mg)	60
Total Carb (g)	0
Dietary Fiber (g)	0
Sugar (g)	0
Protein (g)	0
Vitamin A (µg RAE)	0
Vitamin C (mg)	0
Calcium (mg)	0
Iron (mg)	0

(a) (b)

Figure 3.1: Symbols used in health icons treatment are as follows; (a) a symbol represents food items that are relatively unhealthy e.g. Pepsi, Mountain Dew, Original Iced Tea LIPTON, Lemonade Tropicana, Cheese Pizza, Pepperoni Pizza, Local Bacon Cheeseburger, Macaroni & Cheese, Doritos Nacho Cheese, Chocolate Chip Cookies, Brownie Bar, and (b) a symbol represents food items that are relatively healthy e.g. Green Salad with Sesame Oriental/Balsamic Dressing, Green Salad with Tuna with Sesame Oriental/Balsamic Dressing, Veggie Cup with Hummus/Ranch, Lean Turkey Whole Grain Sandwich, Fresh Apple, Fresh Banana, Fresh Orange.

Table 3.4: A list of all pop-up health claims associated with items offered on the lunch menu

Health claims	Food menu
Sugary beverages increase the risk of developing diabetes. Drinking less than two sugary drinks daily leads to a 27% higher risk of developing diabetes. Sugary beverages also contain a high level of sodium, which raises blood pressure and increases risk of developing heart disease and stroke (Malik et al., 2010; Johnson et al., 2009).	Pepsi, Mountain Dew, Original Iced Tea LIPTON, Lemonade Tropicana
Fiber maintains the health of the digestive tract and lowers the risk of certain cancers, heart disease, and diabetes. Fiber is useful for weight management, as it helps control the appetite (Physicians Committee for Responsible Medicine, 2012).	Green Salad with Sesame Oriental/Balsamic Dressing, Veggie Cup with Hummus/Ranch, Lean Turkey Whole Grain Sandwich, Fresh Apple
Regular consumption of EPA and DHA, which are Omega-3 fatty acids, is associated with reduced cardiac deaths among individuals with and without pre-existing cardiovascular disease (MacKay, 2012).	Green Salad with Tuna with Sesame Oriental/Balsamic Dressing
Consumption of cholesterol and saturated fatty acids causes higher blood cholesterol levels, which is one of the risk factors for heart disease. High sodium contained in this product raises blood pressure, which increases the risk of heart disease and stroke (American Heart Association, 2012; U.S. Food and Drug Administration, 2013).	Cheese Pizza, Pepperoni Pizza, Local Bacon Cheeseburger, Macaroni & Cheese, Doritos Nacho Cheese
Dietary potassium can lower blood pressure, reduce risk of developing kidney stones and decrease bone loss (USDA, 2012).	Fresh Banana, Fresh Orange
This product contains added sugar, which increases caloric intake without providing any nutrient adequacy. The sodium contained in this product raises blood pressure, which increases the risk of heart disease and stroke (USDA, 2010; U.S. Food and Drug Administration, 2013).	Chocolate Chip Cookies, Brownie Bar

3.2 Econometric Model and Estimation

3.2.1 Difference-in-differences model

To investigate the effect of each treatment, the total amount of several nutrients for all items selected on each menu for all participants was calculated. Nutritional information used for a calculation of food items was based on Food-A-Pedia, a USDA online nutrition information database, while nutrition information of beverages was obtained from the manufacturers' official website or directly the nutrition label on the bottle, when such information was not available online. The nutrients of concern of the study that were used as an indication of the healthiness of food consumption were total calories, total fat, saturated fat, cholesterol, carbohydrate, added sugar, and sodium as these nutrients are normally associated with obesity and other negative health consequences.

A difference-in-differences (DID) regression model was employed to determine whether the impact of each treatment was statistically significant. The basic premise of DID is to examine the effect of treatments by comparing the difference of pre- and post-treatment groups to the pre- and post-control group. To control for the unobserved, but intrinsic, factors, the DID method uses the control group to subtract out those influential unobserved factors assuming that they are identical between the treatment and control groups. This method also assumes that the composition of the two groups remains the same over the course of experiment. This removes biases in the post-period comparison between the treatment and control group that could be the result of permanent differences between those groups.

To estimate the treatment effect, the DID estimator can be written as $(y_{11} - y_{10}) - (y_{01} - y_{00})$, where y_{it} is the outcome of interest for group i, (i = 0 for the control and 1 for the treatment), period t (t = 0 for the pre-treatment period and 1 for the post-treatment period). Alternatively, a regression-based estimator can use the level of the outcome variable to estimate the model:

$$y_{it} = \alpha + \beta D_i + \gamma T_t + \delta D_i T_t + \theta C_i + \varepsilon_{it} \tag{1}$$

where y_{it} is the outcome of interest for group i in period t. D_i is a group dummy variable that equals 1 if the individual is in the treatment and 0 if the individual is in the control. T_t is a dummy variable for period that equals 1 if in the post-treatment period (second modified menu with nutrition information provided) and 0 in the pre-treatment period (initial menu with no nutrition information provided). C_i is a demographic variable of each individual, and D_iT_t is an interaction of group and time variable. The OLS estimate of the coefficient, δ, on the interaction term is interpreted as a consistent estimator of the treatment effect.

In order to examine the effect of the various types of menu labeling format, we conducted four different labeling format treatments and one control group. A summary of experimental design was presented in Table 3.5.

Table 3.5: Diagram of experimental design menus

Periods	Control	Treatments			
		Group 1	Group 2	Group 3	Group 4
Pre-treatment (First menu)	No nutrition information	No nutrition information	No nutrition information	No nutrition information	No nutrition information
Post-treatment (Second menu)	No nutrition information	Caloric information	Full nutrition facts panel	Health icons	Health claims

Our dependent variable y_{it} is the total value intake of a particular nutrient for group i in period t. We denoted a dummy variable of calorie-only format, full nutrition facts panel, healthy-unhealthy icons, and health claims treatment as D_1, D_2, D_3, D_4 respectively. The pre- and post-treatment, which were conducted with the same participants, were denoted as dummy variables with T_0 and T_1 respectively. The coefficients of the interaction terms: D_1T_1, D_2T_1, D_3T_1, and D_4T_1 are estimators showing the impact of calorie-only format ($\hat{\delta}_1$), full nutrition facts panel ($\hat{\delta}_2$), healthy-unhealthy icons ($\hat{\delta}_3$), and health claims ($\hat{\delta}_4$) respectively. Thus, the regression was estimated by the following specification:

$$y_{it} = \alpha + \beta_1 D_1 + \beta_2 D_2 + \beta_3 D_3 + \beta_4 D_4 + \gamma T_1 + \delta_1 D_1 T_1 + \delta_2 D_2 T_1 + \delta_3 D_3 T_1 + \delta_4 D_4 T_1 + \theta C_i + \varepsilon_{it} \quad (2)$$

In addition to the assumptions of the OLS model, the validity of the DID estimator requires a "parallel trend" assumption, stating that the underlying trends in the outcome variable is the same for both the control and treatment groups in the absence of the treatments. The small deviations from the assumptions may not matter much as the biases they introduce may be rather small. However, it is also possible that the biases may be so large that the estimates may be completely wrong, even of the opposite sign of the true treatment effect. To verify whether there are any other pre-existing differences in trends, more data on other time periods before and after treatment have to be collected. Nevertheless, it was difficult to obtain such data elsewhere as the experiment was already conducted in the laboratory. Instead, we verified a parallel trend assumption by replacing the total value intake of a particular nutrient (*y*) with another outcome (*y*') that is not likely affected by the treatment. In this case, we used the total expense on the menu as a proxy of another outcome (*y*'), which is assumed not to be affected by the labeling formats. We presumed that either with the presence or the absence of labeling, participants would optimize their $10 budget endowment for each menu with a selection of food varieties in the same range of prices. The result showed that the DID using *y*' is not statistically different from zero, indicating that estimators obtained from our DID model is unlikely to be biased.

3.2.2 Ordered probit model

In addition to the evaluation of the overall change in each nutrient between two menu conditions, we explored changes in consumers' perception in selecting healthier food by comparing the number of relatively healthy items between the initial menu and the modified menu with certain types of nutrition information. This investigation helps to capture changes in healthy food perception that might be missed out when looking solely at the changes in nutrient contents as sometimes general perception about whether a food item is healthy or not can be inconsistent with the actual nutrition facts based on USDA information. Some food items that are generally perceived as healthy contain higher amount of certain bad nutrients than items that are generally perceived as unhealthy. For example, a tuna salad with light dressing contains higher sodium than cheese pizza or pepperoni pizza. Or a banana, apple, and orange each contains more carbohydrate than a cookie. Thus, directly measuring general health perception based on food items can also serve as another assessment for the impact of each menu labeling format.

Food and beverage items were carefully selected to be offered on the menu in order to avoid any misleading perception about their healthiness and they can be clearly divided into two groups, which were relatively healthy item and relatively unhealthy item. The categorization was based on the overall level of bad nutrients, such as total calories, total fat, saturated fat, cholesterol, carbohydrate, sodium, and added sugar, containing in the products relative to other items in the same product category (beverage, entrée, and dessert). There were equal numbers of relatively healthy and relatively unhealthy items in each product category.

- For beverages, relatively healthy items were Diet Pepsi, Gatorade Low Calories, Unsweetened Ice Tea Lipton, and bottled water while relatively unhealthy items consisted of Pepsi, Mountain Dew, Original Ice Tea Lipton, and Lemonade Tropicana.
- For entrées, green salad with sesame oriental/balsamic dressing, green salad with tuna with sesame/balsamic dressing, veggie cup with hummus, and lean turkey whole grain sandwich were among relatively healthy items while

relatively unhealthy items included cheese pizza, pepperoni pizza, local bacon cheeseburger, and macaroni & cheese.

– Among desserts, fresh apple, fresh banana, and fresh orange were among relatively healthy items while relatively unhealthy items included Doritos Nacho Cheese, chocolate chip cookies, and brownie bar.

The impact of four menu labeling treatments and important demographic variables on the number of relatively healthy items selected can be assessed by employing an ordered probit regression model where the dependent variable is ordinal, but not continuous. In this case, the dependent variable was represented by three discrete possible outcomes, which were 1) an increase in total number of relatively healthy items selected from the first to the second menu (denoted by 2), 2) the same number of total relatively healthy items selected from both menus (denoted by 1), and 3) a decrease in number of relatively healthy items selected from the first to the second menu (demoted by 0). An ordered probit regression model for our study can then be specified as:

$$y_i = \alpha + \beta_1 D_1 + \beta_2 D_{2+} \beta_3 D_{3+} \beta_4 D_4 + \theta C_i + \varepsilon_i \tag{3}$$

where y_i represents three possible outcomes from changing eating behavior from the first menu to the second menu (e.g. 0, 1, 2). Dummy variables for four menu labeling formats of calorie-only information, nutrition facts panel, health icons, and health claims, are denoted as $D_{1,}$ $D_{2,}$ $D_{3,}$ D_4 respectively. C_i is a demographic variable of each individual.

3.3 Econometric Results

A total of 298 university students from five menu format conditions participated in the economic experiment, 43 in the control group, 57 in the calorie-only information treatment, 67 in the nutrition facts panel treatment, 66 in the health icons treatment, and 65 in the health claims treatment. Demographic characteristics of participants are presented in Table 3.6. More females (62.8%) than males (37.2%) participated. Caucasian and Asian/Asian American comprised the two largest racial/ethnic groups with 43% and 37.2% respectively, followed by African American (10.1%), Hispanic (6%), and others (3.7%). The majority of participants reported their body weight as normal (65.4%), with 29.5% as underweight and 5.1% as overweight and obese. Approximately one-fourth of participants bought organic products.

Table 3.7 presents mean and standard deviation for food nutrients categorized by each experimental condition. A control condition includes food selected in the initial menu from all four treatments and the controlled group. All of the four intervention labeling formats had lower average intake of bad nutrients for overall health, including calories, total fat, saturated fat, cholesterol, carbohydrate, sodium, and added sugar, compared with the control group. There was one exception with slightly higher average carbohydrate consumption than control group in nutrition facts panel treatment.

Table 3.6: Demographic characteristics of participants by experimental conditions

			Treatments			
	Total % (n)	Control % (n)	Calorie-only % (n)	Nutrition facts panel % (n)	Health icons % (n)	Health claims % (n)
Gender						
Male	37.2 (111)	39.5 (17)	42.1 (24)	52.2 (35)	36.4 (24)	16.9 (11)
Female	62.8 (187)	60.5 (26)	57.9 (33)	47.8 (32)	63.6 (42)	83.1 (54)
Age (years)						
21 or less	50.0 (149)	62.8 (27)	54.4 (31)	47.8 (32)	39.4 (26)	50.8 (33)
More than 21	50.0 (149)	37.2 (16)	45.6 (26)	52.2 (35)	60.6 (40)	49.2 (32)
Ethnicity						
Caucacian	43.0 (128)	39.5 (17)	38.6 (22)	43.3 (29)	44.0 (29)	47.7 (31)
Asian/Asian American	37.2 (111)	44.2 (19)	38.6 (22)	37.3 (25)	33.3 (22)	35.4 (23)
African American	10.1 (30)	11.6 (5)	15.8 (9)	7.4 (5)	7.6 (5)	9.2 (6)
Hispanic/Latino	6.0 (18)	4.7 (2)	1.7 (1)	6.0 (4)	10.6 (7)	6.2 (4)
Others	3.7 (11)	0.0 (0)	5.3 (3)	6.0 (4)	4.5 (3)	1.5 (1)
Education level						
High school	45 (134)	79.1 (34)	42.1 (24)	61.2 (41)	36.4 (24)	16.9 (11)
College graduate or higher	55 (164)	20.9 (9)	57.9 (33)	38.8 (26)	63.6 (42)	83.1 (54)
Smoking						
Yes	3.7 (11)	2.3 (1)	7.0 (4)	1.5 (1)	4.5 (3)	3.1 (2)
No	96.3 (287)	97.7 (42)	93.0 (53)	98.5 (66)	95.5 (63)	96.9 (63)
Drinking Alcohol						
Yes	62.1 (185)	62.8 (27)	61.4 (35)	64.2 (43)	62.1 (41)	60.0 (39)
No	37.9 (113)	37.2 (16)	38.6 (22)	35.8 (24)	37.9 (25)	40.0 (26)
Buying organic products						
Yes	24.2 (72)	16.3 (7)	31.6 (18)	22.4 (15)	25.8 (17)	23.1 (15)
No	75.8 (226)	83.7 (36)	68.4 (39)	77.6 (52)	74.2 (49)	76.9 (50)
Body weights self-assessment						
Underweight	29.5 (88)	4.6 (2)	42.1 (24)	40.3 (27)	36.4 (24)	16.9 (11)
Normal weight	65.4 (195)	72.1 (31)	57.9 (33)	52.2 (35)	63.6 (42)	83.1 (54)
Overweight	5.1 (15)	23.3 (10)	0.0 (0)	7.5 (5)	0.0 (0)	0.0 (0)
Number of subjects (N)	298	43	57	67	66	65

Table 3.7: Descriptive statistics (mean and standard deviation) of nutrients by experimental conditions

	All	Control[a]	Treatments: Calorie-only	Nutrition facts panel	Health icons	Health claims
Calories intake	541.4 (284.4)	554.8 (293.9)	503.2 (278.7)	547.3 (271.5)	485.7 (270.0)	457.9 (271.9)
Total fat intake	20.69 (14.4)	21.24 (14.77)	20.33 (14.70)	19.69 (13.16)	18.48 (14.13)	16.80 (12.67)
Saturated fat intake	6.785 (6.376)	7.134 (6.586)	6.719 (6.405)	6.373 (5.864)	5.758 (6.038)	4.60 (5.385)
Cholesterol intake	52.07 (43.69)	53.49 (44.75)	50.12 (46.35)	51.51 (39.67)	46.38 (45.99)	41.35 (39.11)
Carbohydrate intake	66.77 (39.98)	69.15 (41.46)	60.03 (32.11)	69.22 (43.78)	59.15 (33.74)	55.66 (40.83)
Sodium intake	974.4 (591.9)	984.5 (610.3)	941.1 (586.9)	942.8 (568.7)	937.4 (614.0)	885.6 (561.5)
Added sugar intake	21.83 (25.29)	23.40 (26.06)	17.91 (22.25)	22.19 (26.11)	20.89 (23.71)	14.85 (22.33)

Value in parenthesis is a standard deviation.

[a] Control represents nutrients from the first menus of a control group and all four treatments.

Table 3.8 shows a comparison of mean and standard deviation of nutrient content of the initial menu and the second modified menu for all treatments. We used a paired t-test to compare the differences between the three main nutrients intake from two menus. For total calories intake, the second menu with calorie-only information and health icons resulted in significantly lower calories relative to the first menu while the results were not significant for nutrition facts panel and health claims treatments. A significant reduction for total fat intake was found in the nutrition facts panel and health icons treatments. In addition, the decrease in carbohydrate intake was statistically significant for all treatments, except the nutrition facts panel one.

Table 3.9 summarizes the number of meals changed after being shown the modified menus with various forms of health-related information by focusing solely on the change in total calories. Out of 43 participants in a control group, 10 (23.3%) did not change any items on the second menu. For the 33 who did change at least one item in their menus, 21 (48.8%) resulted in higher total calories while 12 (27.9%) resulted lower total calories. This result from the control group indicated that participants had a tendency to increase the amount of calories intake in the second menu even though nothing on the menu had changed. With the intervention in the second menu, all four treatments combined showed overall favorable results compared with the control group. The inclusion of health-related information caused participants who would have changed food choice in the second menu that resulted in higher total calories to either stick with their same first menu choice or change towards items that resulted in lower total calories. The number of participants who switched to choices with higher total calories reduced from 48.8% in the control group to 29.4% in treatment groups.

All of the treatments resulted in an improvement in food choice compared to the control group. The health icons treatment was the most influential impacted group with the highest percentage of participants who consumed lower calories in the second menu (45.5%) and the lowest percentage of participants who consumed higher calories in the second menu (22.7%). Comparing the results with those of Table 3.8, it is quite impressive that the significant decline in average total calories in calorie-only and health icons treatments was due to changes in meal ordered by more than one-third of participants (38.6% for calorie-only information group and 45.5% for health icons group).

Table 3.8: Comparison of mean and standard deviation for food nutrients between two menus in each treatment

	Control			Treatments											
				Calorie-only			Nutrition facts panel			Health icons			Health claims		
	Menu 1	Menu 2	p-value[a]	Menu 1	Menu 2	p-value[a]	Menu 1	Menu 2	p-value[a]	Menu 1	Menu 2	p-value[a]	Menu 1	Menu 2	p-value[a]
Calories intake	615.7 (263.9)	701.1 (212.6)	0.013	558.1 (294.7)	503.2 (278.7)	0.101	574.5 (318.0)	547.3 (271.5)	0.187	558.33 (301.56)	485.7 (270.0)	0.017	487.8 (274.1)	457.9 (271.9)	0.205
Total fat intake	24.23 (13.54)	28.16 (13.76)	0.028	21.61 (14.81)	20.33 (14.70)	0.272	21.94 (15.88)	19.69 (13.16)	0.072	21.89 (16.05)	18.48 (14.13)	0.015	17.57 (12.54)	16.80 (12.67)	0.311
Carbohydrate intake	73.65 (38.04)	83.84 (33.24)	0.052	70.42 (359.17)	60.03 (32.11)	0.020	72.40 (47.39)	69.22 (43.78)	0.267	68.57 (39.42)	59.15 (33.74)	0.035	62.32 (41.44)	55.66 (40.83)	0.097

[a] p-value calculated from paired t-test

Table 3.9: Number of orders changed after being shown nutrition information

		Treatments					
	Control (n=43) % (n)	Calorie-only (n=57) % (n)	Nutrition facts panel (n=67) % (n)	Health icons (n=66) % (n)	Health claims (n=65) % (n)	All treatments (n=255) % (n)	Total (n=298) % (n)
Same choice	23.3 (10)	31.6 (18)	26.9 (18)	31.8 (21)	30.8 (20)	30.2 (77)	29.2 (87)
Choice with higher calories	48.8 (21)	29.8 (17)	34.3 (23)	22.7 (15)	30.8 (20)	29.4 (75)	32.2 (96)
Choice with lower calories	27.9 (12)	38.6 (22)	38.8 (26)	45.5 (30)	38.4 (25)	40.4 (103)	38.6 (115)
Mean calories decrease (n)	-111.24 (33)	80.31 (39)	37.22 (49)	106.6 (45)	43.09 (45)		
	-85.37 (43)	54.95 (57)	27.22 (67)	72.68 (66)	29.83 (65)		

To evaluate the impact of each treatment on food nutrient intake and, at the same time, control for potential differences in demographic composition of the control and treatment groups, a difference-in-differences regression model (equation (2)) was estimated by using ordinary least squares linear regression. The results from running the regression with all demographic variables are shown in Table 3.10. In terms of demographic results, females consumed less total calories, total fat, saturated fat, cholesterol, carbohydrate, and sodium than males. This result is consistent with previous studies (Conklin et al., 2005; Driskell et al., 2008; Gerend, 2008) indicating that females reported a higher percentage than males for their intention to use the nutrition information on the menus to influence their food choices. Participants older than 21 years of age consumed less total calories and carbohydrate than younger subjects, and Asian/Asian American, African Americans, and Caucasians consumed higher total calories and carbohydrate, compared to other races. Additionally, participants who usually buy organic products tended to select food choices that contained lower total calories, total fat, saturated fat, carbohydrate, and added sugar than other participants. However, the result showed that body weight did not have significant impact on the consumption of bad nutrients.

In terms of the effect of the four treatments on level of nutrient intake, the results in Table 3.10 are consistent with the direction of the mean results presented in Table 3.7. Considering total caloric intake, menus with either calorie-only information, nutrition facts panel, health icons, or health claims all led to a significant change in food selections that contained lower calories, compared with the control group. Specifically, participants who were exposed to the menu with health icons

Table 3.10: Coefficients in difference-in-differences regression

	Calories intake	Total fat intake (g)	Saturated fat intake (g)	Cholesterol intake (mg)	Carbohydrate intake (g)	Sodium intake (mg)	Added sugar intake (g)
Calories-only	-140.3** (56.00)	-5.211* (2.681)	-2.335** (1.170)	-8.395 (7.947)	-20.58** (8.179)	-165.2 (115.3)	-5.534 (4.941)
Nutrition facts panel	-112.60** (54.17)	-6.184** (2.594)	-2.970*** (1.132)	-10.10 (7.687)	-13.36* (7.912)	-128.7 (111.6)	-6.043 (4.780)
Health icons	-158.1*** (54.33)	-7.339*** (2.601)	-3.654*** (1.135)	-15.35** (7.710)	-19.60** (7.935)	-191.2* (111.9)	-5.827 (4.794)
Health claims	-115.2** (54.49)	-4.699* (2.609)	-2.591** (1.139)	-9.042 (7.733)	-16.85** (7.960)	-103.8 (112.2)	-7.659 (4.809)
Female	-146.0*** (54.84)	-7.456*** (2.903)	-4.066*** (1.271)	-23.20*** (8.892)	-15.58* (7.701)	-263.5** (120.6)	-5.402 (5.135)
Age 21 years old up	-57.62* (29.26)	-1.102 (1.549)	-0.341 (0.678)	0.725 (4.744)	-11.77*** (4.109)	-16.06 (64.32)	-3.322 (2.739)
Income $80,000 or less	103.3** (47.45)	3.700 (2.512)	1.170 (1.100)	7.877 (7.694)	11.97* (6.663)	166.0 (104.3)	2.391 (4.443)
Income $80,001 - $160,000	37.80 (47.13)	0.656 (2.496)	-0.063 (1.093)	0.918 (7.643)	5.334 (6.619)	19.93 (103.6)	-2.330 (4.413)
Income more than $160,001	43.45 (49.53)	0.781 (2.622)	0.563 (1.148)	-1.632 (8.031)	9.552 (6.956)	-7.088 (108.9)	1.723 (4.638)
Smoke	82.27 (74.17)	3.168 (3.927)	0.918 (1.720)	-0.261 (12.03)	12.75 (10.42)	164.7 (163.1)	2.541 (6.945)
Drink alcohol	-1.891 (30.63)	0.341 (1.622)	0.137 (0.710)	-1.053 (4.966)	-0.535 (4.301)	27.58 (67.33)	1.454 (2.868)
Buy organic food	-82.72*** (32.25)	-3.126* (1.708)	-1.820** (0.748)	-4.659 (5.230)	-15.25*** (4.530)	-65.66 (70.91)	-9.187*** (3.020)
Consider underweight	-100.48 (84.47)	-4.890 (4.473)	-1.144 (1.959)	-18.99 (13.70)	-6.756 (11.86)	-174.8 (185.7)	-0.562 (7.910)
Consider normal weight	-46.72 (68.81)	-2.591 (3.643)	0.056 (1.595)	-15.56 (11.16)	1.667 (9.663)	-85.25 (151.3)	3.278 (6.443)
Asian/Asian American	210.3*** (76.09)	7.015* (4.029)	2.869 (1.764)	18.32 (12.34)	31.24*** (10.69)	190.8 (167.3)	16.29** (7.125)
Hispanic/Latino	69.64 (91.47)	2.202 (4.843)	1.631 (2.121)	3.762 (14.83)	16.42 (12.85)	-92.65 (201.1)	9.490 (8.565)
African American	196.3** (84.02)	5.883 (4.449)	3.339* (1.948)	14.14 (13.62)	34.76*** (11.80)	67.52 (184.7)	15.80** (7.867)
Caucasian	189.7** (74.34)	6.828* (3.936)	2.579 (1.724)	14.74 (12.05)	27.40*** (10.44)	185.2 (163.4)	9.222 (6.961)
Constant	527.7*** (112.3)	23.35*** (5.927)	7.730*** (2.595)	73.50*** (18.13)	51.75*** (15.79)	1093.0*** (246.4)	14.44 (10.49)

***,**,* represent 99%, 95%, and 90% confidence interval respectively.

Value in parenthesis is a standard deviation.

consumed 158.1 fewer calories than those in control group, representing a 28.5% reduction relative to the control (second menu). The impact of this treatment is the most statistically significant (p-value = 0.004). Participants in the calorie-only, health claims, and nutrition facts panel treatments decreased the amount of their calories intake by 140.3 calories, 115.2 calories, and 112.6 calories respectively compared to the control group, which accounted for a calorie reduction of 25.3%, 20.8%, and 20.3% respectively. The changes in calorie content in these three treatments were statistically significant at the 5% level. Participants in the nutrition facts panel group were exposed to the most detailed nutrition information on the menu; however, their decisions regarding food choices were the least influenced by the information. On the contrary, the health icons, which convey a simple message of whether the food items are relatively healthy or unhealthy, had the highest impact among treatments. Thus, it appears that a menu label format that provides an easy-to-understand connection between nutrition intake and health is an effective means of communicating and encouraging a selection of healthy diets.

Apart from the impact of all types of labeling formats on total calories intake, we investigated their influences on the intake of other nutrients that are associated with obesity and overall health. The results for the total fat, saturated fat, and carbohydrate were quite similar in that the four types of formats had a statistically significant (at the 10% level or better) impact on these nutrients consumption. Regarding total fat intake and saturated fat, the health icons group still generated the greatest nutrient reduction of 7.339 grams (34.6%) and 3.654 grams (51.2%) respectively at the 1% significance level. The nutrition facts panel superseded the other two treatments as the second rank with a decrease in total fat and saturated fat intake of 6.184 grams (29.1%) and 2.97 grams (41.6%) at the 5% and 1% significance level respectively. The change of ranking is possibly due to the fact that the prominent presentation of these nutrients on the menu board triggered participants' health concern. This result is consistent with the finding by Marietta et al. (1999) and Driskell et al. (2008) that college students focused only on certain nutrient information and fat content was the one of their major concern.

Menus with calorie-only, health icons, and health claims caused a reduction of carbohydrates intake relative to the control group by 20.58 grams (29.8%), 19.6 grams (28.3%), and 16.85 grams (24.4%) respectively at the 5% significance level. The nutrition facts label had the lowest impact with 13.36 grams reduction (19.3%), but was still significant at the 10% significance level. The health icons group was the only treatment to have a statistically significant negative impact on cholesterol and sodium content of 15.35 milligrams (28.7%) and 191.2 milligrams (19.4%) at the 5% and 10% level respectively. However, being exposed to any of the modified menu labels did not have a statistically significant effect on the added sugar intake, but the direction of change in consumption was still favorable as seen from negative coefficients of all treatment groups. Soda beverages are products that generally have a high concentration of added sugar compared to other food products. It appears that this insignificant result is due to the fact that when deciding to alter their meal choices after seeing the provision of nutrition information on menu, participants chose to alternate within entrée items rather than within beverages.

After considering the impact of each menu format with the entire sample, we further assessed whether the treatment effects were different for sub-samples of some demographic groups by using the DID model and the statistical results are presented in Table 3.11. With regard to the female sub-sample, the result indicated that the health icons group still had a dominant impact in terms of generating the highest total calories, total fat, and carbohydrate reduction compared to other treatment groups at 5%, 10% and 10% significance level respectively. However, regarding sub-sample of participants who usually purchase organic products, the finding showed that none of the menu labeling format had a statistically significant impact on reducing total calories, total fat, and carbohydrate for participants in this group. Perhaps, these participants are already health conscious and consume healthier food and this is supported by the lower means value of these nutrients (457.5 calories, 17.5 grams, 52.9 grams respectively) for participants buying organic products compared to those who do not (568.1 calories, 21.7 grams, 71.2 grams respectively). This finding is similar to the outcome from a study by Finkelstein et al. (2011), which showed that providing nutrition information on the menu did not have significant impact when restaurant patrons were already consuming healthier options.

Next, we explored the change in the number of relative healthy items selected by comparing between the initial menu and the second modified menu. The result is displayed in Table 3.12. There was no restriction on the number of items selected but participants' choice was somewhat constrained by $10 budget for each menu (they could go over the $10, but had to pay for that out of their $15 cash participation compensation). An increase in the number of relatively healthy items related to a decrease in the number of relatively unhealthy items as participants would try to optimize the given budget, indicating an improvement towards healthier food choices. The result showed that for the control group, the number of relatively healthy items selected slightly decreased from 49.1% to 42.2% when participants were presented to the second menu. This is consistent with the results in Table 3.8 showing an increase in total calories in the second menu compared to the first one. On the other hand, the various types of nutrition information provided on the second menu in the four treatments helped reverse this unhealthy food selection pattern. Nutrition facts panel treatment provided the largest increase in the number of relatively healthy items selected by 10.08%, followed by the health icons treatment by 9.77%, the health claims treatment by 7.48%, and calorie-only information treatment by 3.19% respectively.

Table 3.11: Coefficients in difference-in-differences regression (sub-sample)

	Treatments			
	Calorie-only	Nutrition facts panel	Health icons	Health claims
Female				
Calories intake	-131.07* (71.03)	-103.46 (71.52)	-151.09** (67.59)	-56.60 (64.66)
Total fat intake	-4.37 (3.134)	-2.28 (3.156)	-5.65* (2.983)	-2.39 (2.853)
Carbohydrate intake	-15.94 (10.40)	-17.27* (10.47)	-18.10* (9.895)	-6.08 (9.465)
Buying organic products				
Calories intake	-44.03 (110.8)	-89.94 (113.9)	-108.2 (111.7)	-8.68 (113.9)
Total fat intake	-0.4603 (5.825)	-6.171 (5.986)	-5.924 (5.873)	0.4952 (5.986)
Carbohydrate intake	-5.317 (14.95)	-4.095 (15.36)	-6.840 (15.07)	-4.029 (15.36)

***,**,* represent 99%, 95%, and 90% confidence interval respectively.

Value in parenthesis is a standard deviation.

Table 3.12: Sales of healthy menu items

Condition	Pre-period			Post-period			% Change
	Healthy items	All items	% Healthy	Healthy items	All items	% Healthy	
Control	53	108	49.07%	49	116	42.24%	-6.83%
Calories-only	91	153	59.48%	94	150	62.67%	3.19%
Nutrition facts panel	82	165	49.70%	107	179	59.78%	10.08%
Health icons	86	159	54.09%	106	166	63.86%	9.77%
Health claims	103	160	64.38%	120	167	71.86%	7.48%
Total	415	745	55.70%	476	778	61.18%	5.48%

In addition to a percentage comparison, we further assessed the impact of four menu labeling treatments and important demographic variables on the number of relatively healthy items selected through an ordered probit regression model. The results are shown in Table 3.13. All types of menu intervention had positive coefficients, indicating that they encouraged participants to select more healthy items after providing them with health-related information on the menu. Surprisingly, nutrition facts panel treatment became the most influential menu format relative to the other three formats that guided participants towards healthy choices at the 5% significance level. The health icons and health claims treatments gave statistically significant results at the 10% level while the result for calorie-only information treatment was not significant.

We separately analyzed the impact of each treatment on individual categories of the relatively healthy items selected to see whether beverages, entrée, or dessert drove a change in menu selection towards healthier choices. We found that the main change in choice was heavily based on a change for main entrée items. The positive coefficients for all treatments revealed their positive relationship with the number of healthy items chosen. The impact of the nutrition facts panel, health icons, and health claims treatments were also statistically significant at the 5% level.

Nevertheless, the ordered probit regression is a non-linear model and its estimated coefficients cannot be directly interpreted as for traditional regression model. They have to be further calculated to obtain the probability of getting different types of changes in the total number of relatively healthy items. The Average Marginal Effect (AME) method is used to calculate the marginal effect of menu labeling format as well as some significant demographic characteristics. The results are shown in Table 3.14. Considering the meal selection across all categories, being presented to menus featuring nutrition facts, health icons, and health claims improved the probability of choosing an increasing number of relatively healthy items by 19.5%, 15.7%, and 13.9% while, at the same time, these menu labeling formats decreased a probability of choosing a lower number of relatively healthy items by 14.5%, 11.7%, and 10.4% respectively. Participants of the nutrition facts treatment were less likely to select the same number of relatively healthy items by 5.0%. These results were statistically significant at a 10% level or better.

Some demographic characteristics also had significant impact on meal selection pattern. Participants older than 21 years of age increased (decreased) the chance of selecting higher (lower) number of relatively healthy items by 10.4% (7.7%) at the 5% significance level. Additionally, participants who were Asian or Hispanic increased (decreased) a chance of selecting higher (lower) number of relatively healthy items by 25.9% (19.2%) and 35.6% (26.4%) respectively at the 5%

significance level, compared to 24.2% (18.0%) and 21.1% (15.7%) for those who were African American and Caucasian respectively at the 10% level.

Table 3.13: Ordered Probit regression for selecting higher number of relatively healthy items

Independent Variable	Coefficient estimate			
	All categories	Beverage items	Entrée items	Dessert items
Calories-only	0.232 (0.262)	0.254 (0.294)	0.327 (0.296)	-0.174 (0.281)
Nutrition facts panel	0.599** (0.242)	0.368 (0.272)	0.626** (0.274)	0.400 (0.258)
Health icons	0.482* (0.257)	0.200 (0.287)	0.608** (0.292)	0.218 (0.275)
Health claims	0.427* (0.252)	0.171 (0.281)	0.647** (0.285)	0.036 (0.269)
Female	0.126 (0.268)	0.438 (0.306)	-0.111 (0.307)	0.180 (0.287)
Age 21 years old up	-0.319** (0.144)	-0.253 (0.160)	-0.218 (0.162)	-0.199 (0.153)
Income $80,000 or less	0.367 (0.233)	0.295 (0.258)	0.299 (0.266)	0.177 (0.248)
Income $80,001 - $160,000	0.298 (0.231)	0.021 (0.256)	0.163 (0.264)	0.294 (0.256)
Income more than $160,001	0.202 (0.242)	0.422 (0.271)	0.186 (0.277)	-0.118 (0.259)
Smoke	-0.177 (0.362)	0.277 (0.402)	-0.195 (0.415)	-0.049 (0.378)
Drink alcohol	0.106 (0.150)	0.108 (0.166)	0.128 (0.170)	-0.075 (0.159)
Buy organic food	0.045 (0.158)	-0.159 (0.175)	0.067 (0.176)	0.125 (0.167)
Consider underweight	0.042 (0.416)	-0.071 (0.465)	0.788* (0.460)	0.028 (0.443)
Consider normal weight	0.086 (0.337)	-0.410 (0.375)	0.942** (0.376)	0.161 (0.357)
Asian/Asian American	0.792** (0.371)	0.856** (0.416)	0.817* (0.435)	0.165 (0.405)
Hispanic/Latino	1.090** (0.451)	0.982** (0.502)	0.813 (0.517)	0.430 (0.484)
African American	0.743* (0.411)	0.537 (0.453)	0.538 (0.477)	0.222 (0.446)
Caucasian	0.646* (0.362)	0.420 (0.402)	0.727* (0.425)	0.217 (0.397)
Cut-point 1	0.42 (0.542)	-0.468 (0.600)	0.599 (0.614)	-0.686 (0.580)
Cut-point 2	2.004 (0.550)	2.046 (0.614)	3.22 (0.643)	1.553 (0.584)

***,**,* represent 99%, 95%, and 90% confidence interval respectively.
Value in parenthesis is a standard deviation.

Table 3.14: Marginal effect from an ordered probit regression

Independent variable	Marginal effect											
	All categories			Beverage items			Entrée items			Dessert items		
	Pr(Y=0)	Pr(Y=1)	Pr(Y=2)	Pr(Y=0)	Pr(Y=1)	Pr(Y=2)	Pr(Y=0)	Pr(Y=1)	Pr(Y=2)	Pr(Y=0)	Pr(Y=1)	Pr(Y=2)
Calories-only	-0.056	-0.019	0.076	-0.040	-0.015	0.055	-0.041	-0.034	0.075	0.033	0.009	-0.042
Nutrition facts panel	-0.145**	-0.05**	0.195**	-0.058	-0.021	0.079	-0.079**	-0.065*	0.144**	-0.076	-0.021	0.097
Health icons	-0.117*	-0.04	0.157*	-0.032	-0.011	0.043	-0.077**	-0.064*	0.140**	-0.041	-0.011	0.053
Health claims	-0.104*	-0.036	0.139*	-0.027	-0.010	0.037	-0.082**	-0.068*	0.150**	-0.007	-0.002	0.009
Female	-0.030	-0.011	0.041	-0.069	-0.025	0.094	0.014	0.012	-0.026	-0.034	-0.009	0.044
Age 21 years old up	0.077**	0.027*	-0.104**	0.04	0.015	-0.054	0.028	0.023	-0.05	0.038	0.01	-0.048
Income $80,000 or less	-0.089	-0.031	0.12	-0.047	-0.017	0.063	-0.038	-0.031	0.069	-0.033	-0.009	0.042
Income $80,001 - $160,000	-0.072	-0.025	0.097	-0.003	-0.001	0.005	-0.021	-0.017	0.038	-0.056	-0.015	0.071
Income more than $160,001	-0.049	-0.017	0.066	-0.067	-0.024	0.091	-0.023	-0.019	0.043	0.022	-0.006	-0.028
Smoke	0.043	0.015	-0.058	-0.044	-0.016	0.06	0.025	0.02	-0.045	0.009	0.003	-0.012
Drink alcohol	-0.026	-0.009	0.034	-0.017	-0.006	0.023	-0.016	-0.013	0.03	0.014	0.004	-0.018
Buy organic food	-0.011	-0.004	0.015	0.025	0.009	-0.034	-0.008	-0.007	0.015	-0.024	-0.007	0.03
Consider underweight	-0.012	-0.004	0.014	0.011	0.004	-0.015	-0.100*	-0.083	0.182*	-0.005	-0.001	0.007
Consider normal weight	-0.021	-0.007	0.028	0.065	0.023	-0.088	-0.119**	-0.099*	0.218**	-0.030	-0.008	0.039
Asian/Asian American	-0.192**	-0.066*	0.259**	-0.135**	-0.049	0.184**	-0.103*	-0.086*	0.189*	-0.031	-0.009	0.04
Hispanic/Latino	-0.264**	-0.091*	0.356**	-0.155*	-0.056	0.212*	-0.103	-0.085	0.188	-0.081	-0.022	0.104
African American	-0.180*	-0.062	0.242*	-0.085	-0.031	0.116	-0.068	-0.056	0.123	-0.042	-0.012	0.054
Caucasian	-0.157*	-0.054	0.211*	-0.066	-0.024	0.091	-0.092*	-0.076	0.168*	-0.041	-0.011	0.052

Pr(Y=0) is a probability of selecting lower number of relatively healthy items

Pr(Y=1) is a probability of selecting the same number of relatively healthy items

Pr(Y=2) is a probability of selecting higher number of relatively healthy items

***,**,* represent 99%, 95%, and 90% confidence interval respectively.

The marginal effect on different food selection patterns for the specific categories of meal items was also examined. None of the menu labeling treatments had a significant impact on the number of relatively healthy items selected for beverage and dessert categories. However, the effect was prominent in entrée category, where participants in the nutrition facts panel, health icons, and health claims treatments increased (decreased) the probability of selecting a higher (lower) number of relatively healthy items by 14.4% (7.9%), 14.0% (7.7%), and 15.0% (8.2%) respectively at the 5% significance level. It is noted that when looking at entrée alone, the health claims treatment yielded the highest impact on changing eating pattern towards healthier options. Also, within this category, normal weight participants were likely to select more (less) relatively healthy entrées by 21.8% (11.9%), compared to 18.2% (10.0%) of underweight ones.

CHAPTER 4

CONCLUSIONS

Based on our experimental results, the provision of all four types of health-related information at the point-of-purchase in the restaurant has a positive impact on consumers' purchasing decision of healthy meals. However, the degree of influence of each treatment on food selection varied. When considering the general impact on the reduction of bad nutrients, the health icons treatment was found to be the most effective in delivering nutritional information to customers and encouraging its usage in determining food choices, followed by the calorie-only information, health claims, and nutrition facts panel treatments, respectively. In addition, these findings are consistent with most previous studies suggesting that consumers preferred label formats that are easily understandable and require less mental processing. This is especially true for counter-service restaurants where consumers are exposed to menu board information at each dining experience in a shorter time period than table-service restaurants probably due to the time constraint of placing orders and the convenient nature of the service provided (Fitzgerale et al., 2004).

In terms of specific nutrients, menus featuring caloric information and health claims were efficient in guiding consumers to decrease total calories and carbohydrate intake while the impact of the treatment featuring nutrition facts was relatively weak. However, the nutrition facts panel on the menu significantly reduced consumption of total fat and saturated fat. It also had the strongest impact among all treatments on changing subjects' food selection towards relatively healthier options. One reason that the effect of this menu format surpassed the other three formats is due to that fact that other menu formats may just encourage a switch to less unhealthy items, but they were still categorized as relatively unhealthy items. In contrast, the great extent of nutrition information provided by nutrition facts panel may have a stronger impact and trigger consumers to switch food items across category to the relatively healthy ones. Interestingly, changes made on items ordered after the menu intervention mostly came from a change of the chosen entrée, which contradicted the previous study by Dubbert et al. (1984) citing that the preferences for entrée items were strongly formed and more difficult to change than preferences for vegetable and salads.

Even though the experiment's results showed a desirable effect of each type of menu label format to food choice decision, the results from the study should be viewed as upper bound estimates for the various labeling impact, and it is expected that the results would be less impactful in the actual field. As this study was conducted in a laboratory setting, it is important to review the external validity of the results. First, the exposure context of how the health related information was presented to participants was different in the laboratory than in actual restaurants. Various situational and contextual factors, such as computerized menu versus actual menu board, can result in different outcomes. Also, the study was performed over only a short time period, which may not accurately represent the implications of long-term impact of menu labeling initiatives. Disclosure of nutrition information might possibly cause an overreaction response towards healthier choices as participants were previously underestimating the bad nutrients containing in the food. However, the magnitude of the impact might change if consumers' expectation is correctly adjusted after a repeated exposure to the nutrition content of food. In addition, in a laboratory setting, participants know that their decisions are subject to be surveillance and are thoroughly investigated to satisfy the objective of that particular study. This type of environment is not matched with situation in everyday life and it can influence the decision making process of participants. According to Levitt and List (2007), individual's choice of action, which affects his/her utility, is determined by both individual's wealth, indicating that a utility-maximizing individual will maximize $10 budget given for each menu, and the non-monetary moral cost or benefit associated with action. The latter can be generally divided in three groups: the financial externality that an action imposes on others, the set of social norms or legal rules that govern behavior in a particular society, and the effect of scrutiny. With high degree of scrutiny characteristic of the lab and the high stake given ($25 participation payment plus $10 in food vouchers), participants viewed the task they were assigned with more responsibility and felt obligated to alter their behaviors towards the way corresponding to the experimenter's expectation, which conformed with typical social norms and imposed a low moral cost on them. Thus, the results from the laboratory experiment should be generalized to the field with caution. The significant impact of changing food choices towards healthier meals from the use of four types of menu label format should be viewed as only upper bound estimation due to the contributory factors of social norms and scrutiny as stated in the previous literature.

Despite some limitations, the results from this study still contribute to the literature examining the economic effect of menu labeling on consumer purchasing behavior. Although there have been numerous prior studies that have evaluated the impact of various menu labeling formats, the relative effectiveness of different formats have not been investigated in details. This paper measured the causality and direct exposure to all types of menu labeling formats within one experiment, making these policies comparable among each other. An individual food choice comparison before and after the nutrition information exposure was closely evaluated to determine the pattern of change. Also, the choice analysis extended beyond the calculation of simple caloric information to include additional bad nutrients for the entire meal selection. Menus offered to participants contained a complete meal set, including beverage, entrée, and dessert items, which allowed the possibility of capturing the substitution effect across different product categories within a single meal. In addition, in this laboratory setting, prices for both relatively healthy items and less healthy items were set to be in a similar range and there was a $10 budget given for each menu. This removed the price effect and different budget constraint issue.

In conclusion, the study provided results that help strengthen the argument for the effectiveness of the existing, or in some states, prospective nutrition labeling policy implementation. Nutrition information provided at the point of selection raises consumer's awareness regarding nutrient content and promotes an informed healthy diet. Besides the currently imposed caloric information on the menu board of food chain establishments, it is suggested that policymakers consider alternative simplified label formats that could be more effective for influencing healthy food choice of all population groups. Future research area should focus on the impact of various menu labels on people with low nutrition literacy and these formats should be investigated across different restaurants settings, such as table-service restaurants where the restaurant context allows longer time exposure to the menu than counter-service restaurants.

APPENDICES

A1: Socio-demographic questions and answer option list

#	Question	Answer options / Description
1	What is your gender?	Drop-down list: - male - female
2	What is your age?	Drop-down list: - 20 or less - 21-30 - 31-40 - 41-50 - 51 or more
3	What is the highest level of education you have achieved?	Drop-down list: - High School - Undergraduate degree - Associate degree - Graduate degree or higher
4	How would you describe yourself?	Drop-down list: - Caucasian - African American - Asian/Asian American - Hispanic - Native American - Other
5	What is your family household income?	Drop-down list: - Less than $40,000 - $40,001-$80,000 - $80,001-$120,000 - $120,001-$160,000 - Over 160,000 - Decline to answer
6	What is your marital status?	Drop-down list: - single - married - other
7	How many children do you have?	Drop-down list: - no - one - two - three - four - more than four
8	Do you smoke?	Drop-down list: - yes - no
9	Do you drink alcoholic beverages?	Drop-down list: - yes - no
10	How would you describe your health condition?	Drop-down list: - underweight - normal weight - slightly overweight - overweight - obese
11	Do you often buy organic products?	Drop-down list: - yes - no
12	On a scale of 1-5, please rate your preferences on the television segments and advertisements you have just watched. (1 - dissatisfied and 5 - very satisfied): a) TV show b) Menu variety c) Price	Points (a) to (c) are rated from 1 to 5.

A2: List of nutrients containing in each lunch item

	Calories	Calories from Fat	Total Fat (g)	Sat Fat (g)	Tran Fat (g)	Cholesterol (mg)	Sodium (mg)	Total Carb (g)	Dietary Fiber (g)	Sugar (g)	Protein (g)	Vitamin A (µg RAE)	Vitamin C (mg)	Calcium (mg)	Iron (mg)	Added Sugar (g)	Empty Calories
Diet Pepsi	0	0	0	0	0	0	60	0	0	0	0	0	0	0	0	0	0
Pepsi	250	0	0	0	0	0	55	69	0	69	0	0	0	0	0	69	250
Gatorade Low Calorie	45	0	0	0	0	0	270	12	0	12	0	0	0	0	0	12	45
Mountain Dew	290	0	0	0	0	0	100	77	0	31	0	0	0	0	0	31	290
Unsweeten Icetea LIPTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Original Icetea LIPTON	150	0	0	0	0	0	0	39	0	39	0	0	0	0	0	39	150
Lemonade Tropicana	300	0	0	0	0	0	50	72.5	0	70	0	0	150	0	0	70	300
Bottled Water	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Green Salad with Sesame Oriental/Balsamic Dressing	137	0	12	2	0	0	744	7	1	6	1	156	9	29	1	3	4
Green Salad with Tuna with Sesame Oriental/Balsamic Dressing	316	0	13	2	0	46	1265	7	1	6	40	182	9	46	3	3	4
Veggie Cup with Hummus or Light Ranch	84	27	3	0	0	0	156	13	3	10	1	431	7	56	0	0	0
Cheese Pizza (personal pan 6")	517	189	21	9	-	46	1013	60	3	-	23	131	0	353	4	5	123
Pepperoni Pizza (personal pan 6")	530	207	23	9	-	52	1151	57	3	-	23	119	0	298	4	5	137
Local Bacon Cheeseburger	683	369	41	17	-	120	1655	41	3	-	38	122	4	367	2	6	234
Lean Turkey Whole Grain Sandwich	329	99	11	2	-	67	565	26	1	-	29	6	0	100	3	2	8
Macaroni & Cheese	491	198	22	9	-	39	945	54	3	-	19	226	0	350	2	0.5	176
Doritos Nacho Cheese	294	117	13	2	-	0	211	40	3	-	4	2	0	80	1	0	0
Fresh Apple	72	0	0	0	0	0	1	19	3	-	0	4	6	8	0	0	0
Fresh Banana	105	0	0	0	0	0	1	27	3	-	1	4	10	6	0	0	0
Fresh Orange	62	0	0	0	0	0	0	15	3	-	1	14	70	52	0	0	0
Chocolate Chip Cookies	108	54	6	2	0	7	79	13	1	-	1	33	0	8	1	8	37
Brownie Bar	224	72	8	2	0	21	88	37	1	-	3	4	0	20	2	20	134

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